

CLAIMS

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. An inductor structure comprising:

5 a substrate having a first surface,

a first layer of SiCOH dielectric material formed atop said first surface, said first SiCOH dielectric layer having a second surface,

a patterned conductor structure atop said second surface of said first SiCOH dielectric layer, and

10 a second layer of SiCOH dielectric material atop said first SiCOH dielectric layer, covering and surrounding said patterned conductor structure.

2. The structure of Claim 1 wherein said SiCOH dielectric material includes Si, C, O, and H

15 wherein the composition H is in the range from 10 to 55 at %, C is in the range from 5 to 45 at %, Si is in the range from 5 to 40 at %, and O is in the range from 0 to 50 at %.

3. The structure of Claim 1 wherein said SiCOH dielectric material includes Si, C, O, and H wherein the composition H is in the range from 25 to 55 at %, C is in the range from 10 to 40 at %, Si is in the range from 10 to 30 at %, and O is in the range from 10 to 35 at %.

4. The structure of Claim 1 wherein said SiCOH dielectric material includes Si, C, and H without Oxygen, and may contain an additive selected from the group consisting of N, F, and Ge.

5. The structure of Claim 1 wherein said SiCOH dielectric material has a dielectric constant of less than 3.5.

6. The structure of Claim 1 wherein said SiCOH dielectric material has a breakdown field of greater than 4.5 MV/cm.

7. The structure of Claim 1 wherein said SiCOH dielectric material has a leakage current at 1 MV/cm applied field of less than 10 nanoAmps per cm².

8. The structure of Claim 1 wherein said patterned conductor structure has a spiral shape selected from the group consisting of round in the plane of said spiral and square in the plane of said spiral.

9. The structure of Claim 1 wherein said patterned conductor structure has a toroidal shape.

10. A membrane inductor structure comprising:

5 a free-standing first layer of SiCOH dielectric having a top surface and not having a support layer underneath,

a conductor layer patterned into a spiral shape atop said top surface of said dielectric, and

10 a second layer of SiCOH dielectric atop said first SiCOH dielectric layer, covering and surrounding said patterned conductor structure.

11. The structure of Claim 10 wherein said SiCOH dielectric material includes Si, C, O, and H wherein the composition H is in the range from 10 to 55 at %, C is in the range from 5 to 45 at %, Si is in the range from 5 to 40 at %, and O is in the range from 0 to 50 at %.

15 12. The structure of Claim 10 wherein said SiCOH dielectric material includes Si, C, O, and H

wherein the composition H is in the range from 25 to 55 at %, C is in the range from 10 to 40 at %, Si is in the range from 10 to 30 at %, and O is in the range from 10 to 35 at %.

13. The structure of Claim 10 wherein said SiCOH dielectric material includes Si,
5 C, and H without Oxygen, and may contain an additive selected from the group consisting of N, F, and Ge.

14. The structure of Claim 10 wherein said SiCOH dielectric material has a dielectric constant of less than 3.5.

10 15. The structure of Claim 10 wherein said SiCOH dielectric material has a breakdown field of greater than 4.5 MV/cm.

16. A transformer structure comprising:

a substrate having a first surface,

a first conductor patterned as a first closed loop (first winding),

15 a layer of the SiCOH dielectric deposited atop said first conductor and said SiCOH dielectric layer having a second surface, and

a second conductor patterned in a second closed loop atop said second surface of said SiCOH dielectric.

17. The structure of Claim 16 further including a permanent magnet body extending through said first and second closed conductor loops.

5 18. The structure of Claim 16 wherein said SiCOH dielectric material includes Si, C, O, and H wherein the composition H is in the range from 10 to 55 at %, C is in the range from 5 to 45 at %, Si is in the range from 5 to 40 at %, and O is in the range from 0 to 50 at %.

10 19. The structure of Claim 16 wherein said SiCOH dielectric material includes Si, C, O, and H wherein the composition H is in the range from 25 to 55 at %, C is in the range from 10 to 40 at %, Si is in the range from 10 to 30 at %, and O is in the range from 10 to 35 at %.

15 20. The structure of Claim 16 wherein said SiCOH dielectric material includes Si, C, and H without Oxygen, and may contain an additive selected from the group consisting of N, F, and Ge.

21. The structure of Claim 16 wherein said SiCOH dielectric material has a dielectric constant of less than 3.5.

22. The structure of Claim 16 wherein said SiCOH dielectric material has a breakdown field of greater than 4.5 MV/cm.

23. A circuit board structure comprising an insulating substrate,
a plurality of patterned metal conductors formed in a first conductor layer on said first
5 substrate,

a layer of the thick SiCOH dielectric having a thickness greater than 0.5 microns,
formed atop said first conductor layer,

a plurality of patterned metal connectors (vias) formed within said thick SiCOH
dielectric layer,

10 a plurality of patterned metal conductors formed in a second conductor layer atop said
thick SiCOH dielectric,

said first and second conductor layers being electrically connected at selected
locations by said patterned metal connectors (vias).

24. The circuit board structure of Claim 23, further including a second insulating substrate adjacent to said second conductor layer.

25. A circuit board structure comprising more than one substructure in which said substructure further includes a plurality of patterned metal conductors formed in a first conductor layer on said first substrate,

a layer of the thick SiCOH dielectric having a thickness greater than 0.5 microns, formed atop said first conductor layer,

a plurality of patterned metal connectors (vias) formed within said thick SiCOH dielectric layer,

a plurality of patterned metal conductors formed in a second conductor layer atop said thick SiCOH dielectric,

said first and second conductor layers being electrically connected at selected locations by said patterned metal connectors (vias).

26. The circuit board structure of Claim 23 in which said first conductor layer is surrounded by (formed within) a dielectric material of any composition.

19. The circuit board structure of Claim 15 in which said first conductor layer is surrounded by (formed within) said SiCOH dielectric material.

5 28. The structure of Claim 23 wherein said SiCOH dielectric material includes Si, C, O, and H wherein the composition H is in the range from 10 to 55 at %, C is in the range from 5 to 45 at %, Si is in the range from 5 to 40 at %, and O is in the range from 0 to 50 at %.

10 29. The structure of Claim 23 wherein said SiCOH dielectric material includes Si, C, O, and H wherein the composition H is in the range from 25 to 55 at %, C is in the range from 10 to 40 at %, Si is in the range from 10 to 30 at %, and O is in the range from 10 to 35 at %.

15 30. The structure of Claim 23 wherein said SiCOH dielectric material includes Si, C, and H without Oxygen, and may contain an additive selected from the group consisting of N, F, and Ge.

31. The structure of Claim 23 wherein said SiCOH dielectric material has a dielectric constant of less than 3.5.

32. The structure of Claim 23 wherein said SiCOH dielectric material has a breakdown field of greater than 4.5 MV/cm.

5 33. Interconnect structure :

on an integrated circuit, a plurality of patterned metal conductors formed within an organic thermoset dielectric material,

said conductors having a top surface,

said conductors surrounded by a conductive diffusion barrier liner 1 to 10 nm thick,

10 said conductive diffusion barrier liner being on all sides except said top surface of said conductors,

and with mask patterning / CMP stop layer atop said organic dielectric material,

said mask patterning / CMP stop layer comprised of the SiCOH dielectric material, and

15 said mask patterning / CMP stop layer having a top surface that is approximately co-planar with the top surface of said patterned metal conductors.

34. The structure of Claim 33 wherein said SiCOH dielectric material includes Si, C, O, and H wherein the composition H is in the range from 10 to 55 at %, C is in the range from 5 to 45 at %, Si is in the range from 5 to 40 at %, and O is in the range from 0 to 50 at %.

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35. The structure of Claim 33 wherein said SiCOH dielectric material includes Si, C, O, and H wherein the composition H is in the range from 25 to 55 at %, C is in the range from 10 to 40 at %, Si is in the range from 10 to 30 at %, and O is in the range from 10 to 35 at %.

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36. The structure of Claim 33 wherein said SiCOH dielectric material includes Si, C, and H without Oxygen, and may contain an additive selected from the group consisting of N, F, and Ge.

37. The structure of Claim 33 wherein said SiCOH dielectric material has a dielectric constant of less than 3.5.

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38. The structure of Claim 33 wherein said SiCOH dielectric material has a breakdown field of greater than 4.5 MV/cm.

39. Interconnect structure: on an integrated circuit, the structure of Claim 21,

said top surface of said patterned metal conductors and said top surface of said mask patterning / CMP stop layer being in intimate contact with a diffusion barrier layer comprised of Si, C, H or Si, N, C, H, and optionally containing oxygen.

40. A capacitor structure comprised of a substrate having a first surface,
5 a layer of the SiCOH dielectric deposited atop said first surface and said SiCOH dielectric layer having a second surface,
and a patterned conductor layer atop said second surface of said SiCOH dielectric,
said conductor layer comprised of a first electrode region and a second electrode region,

10 said first and second electrodes being electrically isolated and being separated by a capacitor dielectric.

41. The capacitor structure of Claim 40 further including a second layer of the SiCOH dielectric atop said conductor layer and atop said capacitor dielectric (for passivation / air protection).

15 42. On an integrated circuit, the structure of Claim 40 wherein at least 1 of the 2 electrodes is a region of a patterned metal interconnect level of a said IC.

43. The structure of Claim 40 wherein said SiCOH dielectric material includes Si, C, O, and H

wherein the composition H is in the range from 10 to 55 at %, C is in the range from 5 to 45 at %, Si is in the range from 5 to 40 at %, and O is in the range from 0 to 50 at %.

44. The structure of Claim 40 wherein said SiCOH dielectric material includes Si,
5 C, O, and H wherein the composition H is in the range from 25 to 55 at %, C is in the range from 10 to 40 at %, Si is in the range from 10 to 30 at %, and O is in the range from 10 to 35 at %.

45. The structure of Claim 40 wherein said SiCOH dielectric material includes Si,
10 C, and H without Oxygen, and may contain an additive selected from the group consisting of N, F, and Ge.

46. The structure of Claim 40 wherein said SiCOH dielectric material has a dielectric constant of less than 3.5.

47. The structure of Claim 40 wherein said SiCOH dielectric material has a breakdown field of greater than 4.5 MV/cm.

15 48. An interconnect structure on an integrated circuit comprising:

a plurality of patterned metal conductors formed within a dielectric material,

5 said conductors having a top surface, said conductors surrounded by a conductive diffusion barrier liner 1 to 10 nm thick,

10 said conductive diffusion barrier liner being on all sides except said top surface of said conductors, and

5 a mask patterning/cmp stop layer atop said dielectric material,

15 said mask patterning/CMP stop layer comprising said SiCOH dielectric material, and

20 said mask patterning/CMP stop layer having a top surface that is substantially co-planar with the top surface of said patterned metal conductors.

25 49. The structure of claim 48 wherein said dielectric material is an organic polymeric
10 thermoset dielectric.

30 50. The structure of claim 48 wherein the dielectric material is an organic polymeric
thermoset dielectric has porosity wherein said porosity means voids with a dimension
across the void in the range from 1 to 50 nm.

35 51. The structure of Claim 48, wherein said SiCOH dielectric material includes Si,
15 C, O, and H wherein the composition H is in the range from 10 to 55 at %, C is in

the range from 5 to 45 at %, Si is in the range from 5 to 40 at %, and O is in the range from 0 to 50 at %.

52. The structure of Claim 48 wherein said SiCOH dielectric material includes Si, C, O, and H wherein the composition H is in the range from 25 to 55 at %, C is in the range from 10 to 40 at %, Si is in the range from 10 to 30 at %, and O is in the range from 10 to 35 at %.

53. The structure of Claim 48 wherein said SiCOH dielectric material includes Si, C, and H without Oxygen, and may contain an additive selected from the group consisting of N, F, and Ge.

10 54. The structure of Claim 48 wherein said SiCOH dielectric material has a dielectric constant of less than 3.5.

55. The structure of Claim 48 wherein said SiCOH dielectric material has a breakdown field of greater than 4.5 MV/cm.